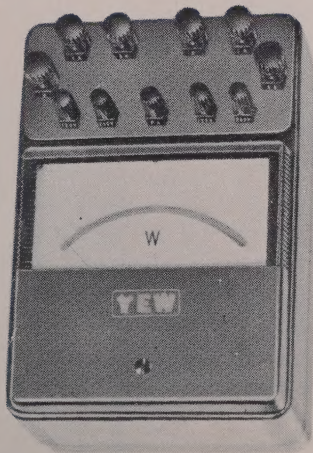


# Instruction Manual

## Type 2042 PORTABLE THREE PHASE WATTMETER



**YEW**

YOKOGAWA ELECTRIC WORKS

IM 2042-01E

## **Type 2042 PORTABLE THREE PHASE WATT-METER**

**Type 2042** is a most reliable instrument developed by YEW's latest techniques and long experience. To operate your **Type 2042** at its full capability for a longer life, please read carefully the instructions contained in this manual.

- \* Any instrument or component thereof which is found within the one year period, not to without charge upon examination by the YEW factory or authorized inspection agency.



## Contents

|                           |   |
|---------------------------|---|
| General .....             | 1 |
| Construction .....        | 2 |
| Specifications .....      | 4 |
| Operating procedure ..... | 5 |

|              |                 |
|--------------|-----------------|
|              |                 |
|              |                 |
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## GENERAL

The **Type 2042** is an electro-dynamometer type, portable, three-phase wattmeter with a taut bend suspension movement. It is designed to measure the electrical power of three-phase, three-wire circuits with high accuracy both in laboratories and in the field. It can also be used to measure DC or single-phase power.



Fig. 1

## CONSTRUCTION

As shown in Fig. 1, this instrument is housed in a strong bakelite case. The indicator movement is completely shielded from external magnetic field effects by means of double permalloy plates. Fig. 1 provides on external view and Fig. 2 shows the internal connections.

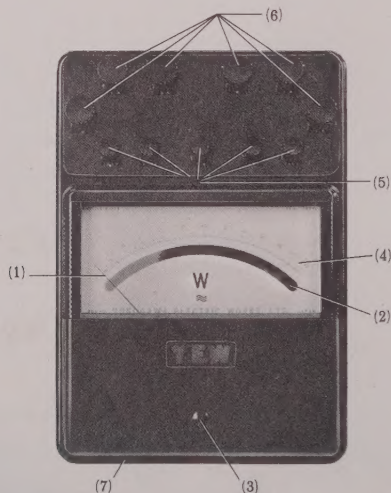


Fig. 1

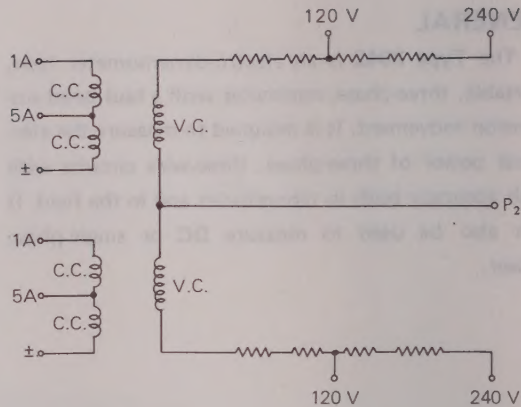


Fig. 2

- (1) Knife-edge Pointer:
- (2) Mirror: This eliminates parallax errors during readout. Line up the pointer with its reflection when reading out values.
- (3) Zero Adjust Screw: This is used for setting the zero position of the pointer when out of adjustment. However, if misalignment is due to the bend pointer, adjusting this screw may cause reading errors.

- (4) Scale: The scale is graduated into 120 divisions (Almost linear).
- (5) Voltage Terminals: Voltages are connected here. The common terminal is marked  $(\pm)$ , while the other terminals indicate their respective rated voltages.
- (6) Current Terminals: Two of the terminals are marked with  $(\pm)$  to indicate that its polarity relation to the voltage coil, and the other terminals indicate their respective rated currents.
- (7) Multiplying Constant table: Located on the side of the instrument, this table is used to obtain actual power from the indicated value. Refer to the Section on Operating Procedure for details.

| Range        | Range        | Range        | Range        | Range        | Range        |
|--------------|--------------|--------------|--------------|--------------|--------------|
| 150 V        | 150 V        | 150 V        | 150 V        | 150 V        | 150 V        |
| 75 V         | 75 V         | 75 V         | 75 V         | 75 V         | 75 V         |
| 30 V         | 30 V         | 30 V         | 30 V         | 30 V         | 30 V         |
| 15 V         | 15 V         | 15 V         | 15 V         | 15 V         | 15 V         |
| 7.5 V        | 7.5 V        | 7.5 V        | 7.5 V        | 7.5 V        | 7.5 V        |
| 3.75 V       | 3.75 V       | 3.75 V       | 3.75 V       | 3.75 V       | 3.75 V       |
| 1.875 V      | 1.875 V      | 1.875 V      | 1.875 V      | 1.875 V      | 1.875 V      |
| 0.9375 V     | 0.9375 V     | 0.9375 V     | 0.9375 V     | 0.9375 V     | 0.9375 V     |
| 0.46875 V    | 0.46875 V    | 0.46875 V    | 0.46875 V    | 0.46875 V    | 0.46875 V    |
| 0.234375 V   | 0.234375 V   | 0.234375 V   | 0.234375 V   | 0.234375 V   | 0.234375 V   |
| 0.1171875 V  | 0.1171875 V  | 0.1171875 V  | 0.1171875 V  | 0.1171875 V  | 0.1171875 V  |
| 0.05859375 V | 0.05859375 V | 0.05859375 V | 0.05859375 V | 0.05859375 V | 0.05859375 V |

## SPECIFICATIONS

Technical specifications and characteristics are as follows:

|                     |                                   |
|---------------------|-----------------------------------|
| Type                | : 2042                            |
| Accuracy            | : $\pm 0.5\%$ of full scale value |
| Over-all dimensions | : Approx. 180 x 260 x 140 mm      |
| Scale length%       | : Approx. 135 mm                  |
| Scale divisions     | : 120                             |
| Over-load capacity  | : Voltage circuit: . . . . 50%    |
|                     | Current circuit: . . . 100%       |

Characteristics:

|                                 |                                                           |
|---------------------------------|-----------------------------------------------------------|
| Self-heating effect             | : Approx. within $\pm 0.25\%$                             |
| External temperature effects    | : Approx. within $\pm 0.3\%/10^\circ\text{C}$             |
| External magnetic field effects | : Approx. within $\pm 1\%/400\text{A/m}$                  |
| Frequency response              | : DC, 25 - 1,000Hz                                        |
| Power factor effect             | : Approx. within $\pm 0.5\%$ , power factor from 1 to 0.5 |

Table 1 Ratings, Internal Impedance, and Rated Power loss VA

| Range              |       | Rating |       | Internal Impedance                  | Rated Power loss VA |
|--------------------|-------|--------|-------|-------------------------------------|---------------------|
| Voltage<br>Current |       | 120 V  |       | Approx 12,000 $\Omega$ each element | Approx 1.2VA x2     |
|                    |       |        | 240 V | " 24,000 "                          | " 2.4 " "           |
| 0.2/1A             | 0.2 A | 48 W   | 96 W  | " 16.35 "                           | " 0.66              |
|                    | 1 A   | 240 W  | 480 W | " 0.56 "                            | " 0.56              |
| 1/5A               | 1 A   | 240 W  | 480 W | " 0.93 "                            | " 0.93              |
|                    | 5 A   | 1.2KW  | 2.4KW | " 0.034 "                           | " 0.84              |
| 5/25A              | 5 A   | 1.2KW  | 2.4KW | " 0.068 "                           | " 1.72              |
|                    | 25 A  | 6KW    | 12KW  | " 0.0027 "                          | " 1.69              |

## OPERATING PROCEDURE

### 1. Preparations

- (1) Place the meter on fairly level surface.
- (2) Check if the pointer is resting at zero on the scale. If not, turn the zero adjusting screw located on the front panel with a screw-driver (Refer to Fig. 1) until the pointer reaches zero.
- (3) Be sure to turn off the power source of the circuit to be measured before connecting the meter to the circuit.

### 2. Connections

#### (1) Three-phase Power Measurement (standard)

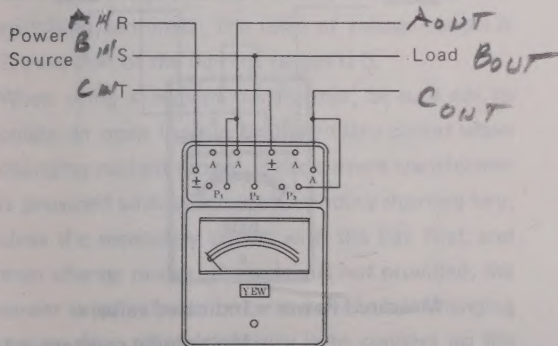


Fig. 3

#### (2) Three-phase Power Measurement when the current exceeds the rated value

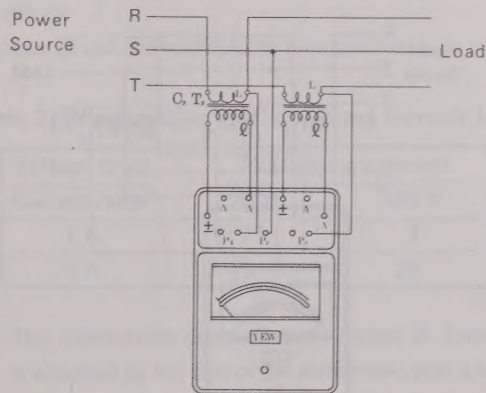


Fig. 4

(Note)

- \* Be sure not to create an open loop in the secondary circuit of the current transformer (C.T.).

- (3) Three-phase Power Measurement when both the voltage and the current exceed the rated values:

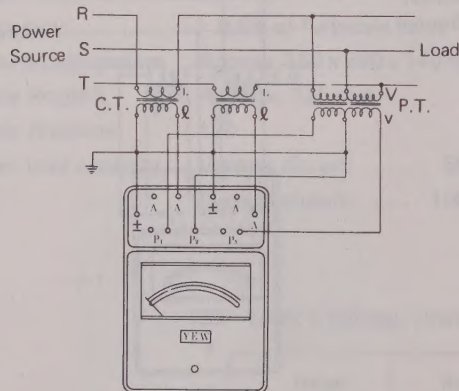


Fig. 5

(Note)

\* As shown in Fig. 5, connect the potential transformer (P.T.) to the voltage circuit, and the current transformer (C.T.) to the current circuit. Obtain the power by the following method:

(indicated value  $\times$  multiplying constant)  $\times$   
CT ratio  $\times$  PT ratio = W

(Example):

Indicated value: 120

Multiplying constant: 10 (120V  $\times$  5A)

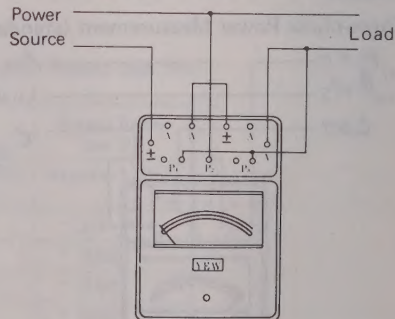
PT ratio: 6,600/110, CT ratio: 50/5

Substitute the above data into the equation:

$$W = 120 \times 10 \times \frac{6,600}{110} \times \frac{50}{5} = 720,000 \text{ Watt}$$

$$= 720 \text{ kW}$$

- (4) DC or single-phase Power Measurement



Measured Power = Indicated value  $\times$   
Multiplying constant  $\times$  1/2

Fig. 6

**(Caution)**

**\* In single-phase power measurements, the value may be 0.2 to 0.3% lower than that in three-phase power measurements.**

### 3. Range Selection

When making any measurement, use the voltage terminal whose rated value is closed to the circuit voltage. If the load current is unknown, connect the circuit to the largest rated current terminal initially. Then apply power to the circuit.

Both the voltage and current ranges are changed by switching terminals. The ratio of voltage ranges is 2. And that of the current ranges is 5.

When using a current transformer, be sure not to create an open loop in the secondary circuit when changing current ranges. If the current transformer is provided with a secondary winding shorting key, close the secondary circuit with the key first, and then change ranges. If the key is not provided, the power supply should be turned off before changing ranges. One other possibility is to connect up the terminal to be used before removing the original

connection (then remove the original connection). The main thing to avoid is an open loop in the secondary circuit of the C.T. with the power supply on.

### 4. How to use the multiplying constant table

Table 2 (Rated voltages 120/240, Rated currents 1/5A)

| Voltage range<br>Current range | Multiplying constant |       |
|--------------------------------|----------------------|-------|
|                                | 120 V                | 240 V |
| 1 A                            | 2                    | 4     |
| 5 A                            | 10                   | 20    |

The multiplying constant table shown in Table 2, is attached to the side of the wattmeter, and is used to convert the value read from the scale into actual measured power. In other words, actual power is obtained as follows:

Load Power = indicated value x multiplying constant

The multiplying constant is derived from the following equation

Multiplying constant =  $2 \times \text{Rated current (A)} \times$   
 $\text{Rated voltage (V)} \times \text{Rated Power Factor (1.0)} / \text{Total number of scale divisions (120)}$

However, this value should be taken from the table (depending on the current and voltage ranges) when measuring power.

For single phase measurements, however, the multiplying constants of table 2 are reduced by a factor of 2. For single phase measurements, refer to Table 3.

Table 3 — Similar to Table 2

| Voltage range | Multiplying constant |       |
|---------------|----------------------|-------|
| Current range | 120 V                | 240 V |
| 1 A           | 1                    | 2     |
| 5 A           | 5                    | 10    |

## 5. Wattmeter Power Consumption Compensation

The value indicated on the wattmeter is the sum of the load power plus the consumed power of the coil (current or voltage coil) connected to the load side. If high accuracy is desired or the rated power of the wattmeter is small (less than 1 kW), the power consumed by the meter must be subtracted from the indicated value.

a) Compensation when the voltage coil is connected to the load side:

The connections are shown in Fig. 7. for a power source with a low impedance, or for a relatively small load power. The power consumption of the voltage coil in this case is almost the same as the value indicated on the scale with no load. Subtract this value from the first readout to ob-

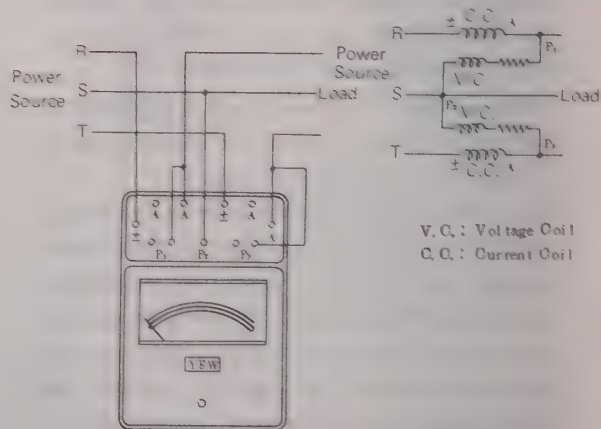


Fig 7

tain the true load power. If the power source impedance is high or the load power is large, the true load power value can be obtained by using a voltmeter, whose internal resistance is known, connected as shown in Fig. 8, and by performing the following calculation.

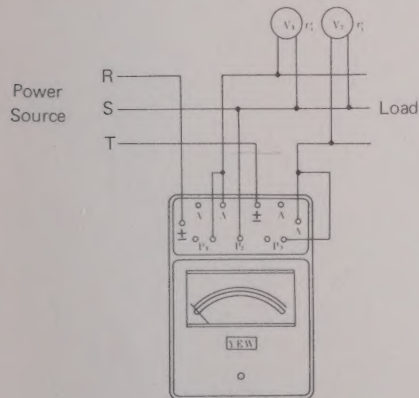


Fig. 8

$$P = W - V_1^2 \left( \frac{1}{r} + \frac{1}{r_1} \right) - V_2^2 \left( \frac{1}{r} + \frac{1}{r_2} \right)$$

$P$  = Load power

$W$  = Power indicated on the wattmeter

$V_1, V_2$  = Voltage indicated on the voltmeter

$r$  = Voltage circuit resistance of wattmeter

$r_1, r_2$  = Internal resistances of voltmeters  $V_1, V_2$

- b) Compensation when the current coil is connected to the load side:

When the current coil is connected to the load side through the voltage coil as shown in Fig. 9, if the voltage connection is moved from point  $P_1$  to point  $Q$ , the meter will indicate the power consumption of the current coil. Subtract this value from the first readout to obtain the true load power.

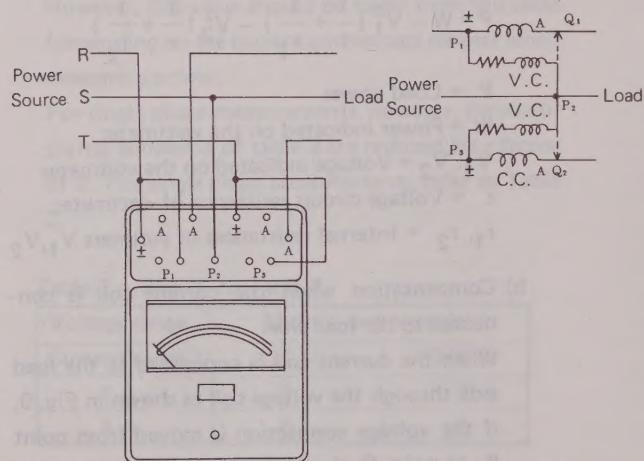
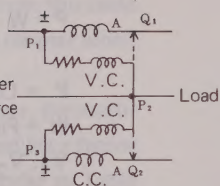


Fig. 9







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